

This is a repository copy of *Iron Age Landscapes of the Benue River Valley, Cameroon*.

White Rose Research Online URL for this paper:

<https://eprints.whiterose.ac.uk/121127/>

Version: Accepted Version

Article:

Wright, David, MacEachern, Scott, Choi, Jungyu et al. (3 more authors) (2017) Iron Age Landscapes of the Benue River Valley, Cameroon. *Journal of Field Archaeology*. pp. 1-15. ISSN 2042-4582

<https://doi.org/10.1080/00934690.2017.1358017>

Reuse

Items deposited in White Rose Research Online are protected by copyright, with all rights reserved unless indicated otherwise. They may be downloaded and/or printed for private study, or other acts as permitted by national copyright laws. The publisher or other rights holders may allow further reproduction and re-use of the full text version. This is indicated by the licence information on the White Rose Research Online record for the item.

Takedown

If you consider content in White Rose Research Online to be in breach of UK law, please notify us by emailing eprints@whiterose.ac.uk including the URL of the record and the reason for the withdrawal request.

Journal of Field Archaeology

Iron Age Landscapes of the Benue River Valley, Cameroon

--Manuscript Draft--

Manuscript Number:	JFA281R1
Full Title:	Iron Age Landscapes of the Benue River Valley, Cameroon
Article Type:	Unsolicited Original Research Paper
Keywords:	Iron Age Africa; Settlement Mounds; Sedimentology; Micromorphology; OSL dating
Corresponding Author:	David K. Wright, PhD Seoul National University Seoul, KOREA, REPUBLIC OF
Corresponding Author Secondary Information:	
Corresponding Author's Institution:	Seoul National University
Corresponding Author's Secondary Institution:	
First Author:	David K. Wright, PhD
First Author Secondary Information:	
Order of Authors:	David K. Wright, PhD
	Scott MacEachern, PhD
	Jungyu Choi, B.A.
	Jeong-Heon Choi, PhD
	Carol Lang, PhD
	Jean-Marie Datouang Djoussou, PhD
Order of Authors Secondary Information:	
Abstract:	Iron Age settlements of northern Cameroon were dispersed across the landscape, taking advantage of different eco-climatic zones to exploit a variety of natural resources. Situated at the cusp of high and low terraces of the Benue River, mound sites in the area around Garoua have occupation histories spanning multiple centuries. The site of Langui-Tchéboua displays evidence for rapid accumulation of sediments approximately 700 years ago, which may have been a deliberate construction strategy that would have allowed the site's inhabitants to exploit resources in both floodplain and dryland contexts. The combined use of multiple dating methods and micromorphology provide novel insights into both the mechanisms of anthropogenic landscape change and possible motivations governing those choices.
Additional Information:	
Question	Response
Author Comments:	n/a
Suggested Reviewers:	Susan K McIntosh, PhD Professor, Rice University skmci@rice.edu Susan is one of the world's leading experts in Iron Age mounds of western Africa.
	Roderick McIntosh, PhD Professor, Yale University roderick.mcintosh@yale.edu Rod is also a foremost expert on mounds in western Africa. He reviewed a paper I (David Wright) wrote for African Archaeological Review last year and provided solid, critical feedback that really improved the quality of the manuscript.

	<p>Stephen Dueppen, PhD Assistant Professor, University of Oregon dueppen@uoregon.edu Stephen has worked on mounds from Burkina Faso in western Africa. He is knowledgeable about the general cultural and depositional context of riverine Iron Age mound sites in western Africa.</p>	
Funding Information:	National Geographic Society (9404-13)	Scott MacEachern
	Seoul National University (International Faculty Research Grant)	Dr. David K. Wright

Iron Age Landscapes of the Benue River Valley, Cameroon

David K. Wright, Seoul National University, Department of Archaeology and Art History, Seoul, 08826, South Korea (msafiri@snu.ac.kr)*

ALSO Department of Archaeology, University of York, York, YO1 7EP, United Kingdom

Scott MacEachern, Bowdoin College, Department of Anthropology, Brunswick, Maine, 04011, United States of America (smaceach@bowdoin.edu)

Jungyu Choi, Seoul National University, Department of Archaeology and Art History, Seoul, 08826, South Korea (jungyu.choi90@gmail.com)

Jeong-Heon Choi, Geochronology Group, Korea Basic Science Institute, Chungbuk, 363-883, South Korea (jhchoi@kbsi.re.kr)

Carol Lang, Department of Archaeology, University of York, York, YO1 7EP, United Kingdom (carol.lang@york.ac.uk)

Jean-Marie Datouang Djoussou, Pavillon Charles de Koninck, Université Laval Québec, Québec, G1V 0A6, Canada (ddjoussoujm2005@yahoo.fr)

* For correspondence

Iron Age Landscapes of the Benue River Valley, Cameroon

Abstract

Iron Age settlements of northern Cameroon were dispersed across the landscape, taking advantage of different eco-climatic zones to exploit a variety of natural resources. Situated at the cusp of high and low terraces of the Benue River, mound sites in the area around Garoua have occupation histories spanning multiple centuries. The site of Langui-Tchéboua displays evidence for rapid accumulation of sediments approximately 700 years ago, which may have been a deliberate construction strategy that would have allowed the site's inhabitants to exploit resources in both floodplain and dryland contexts. The combined use of multiple dating methods and micromorphology provide novel insights into both the mechanisms of anthropogenic landscape change and possible motivations governing those choices.

Introduction

Settlement mounds and mound clusters are widely distributed across western Africa (FIG. 1), in circumstances that seem to be associated with increasing sedentism and intensive forms of land management during the Iron Age (Connah 1981; Klee and Zach 1999). Mounds are variable physically, encompassing a wide variety of different sizes and shapes, and occurring singly or in clusters that may include many smaller mounds. The dynamics of this differentiation is not well-understood, although it probably relates to local settlement patterns, architectural forms and soil types (Connah 1981: 53-56; Holl 2014: 3-10; McIntosh 1999).

26 In the late 1960s, Nicholas David undertook an intensive archaeological
27 survey and series of excavations in the Benue River Valley of northern Cameroon
28 (David 1968, 1981). Thirty-nine settlement mounds and mound complexes were
29 identified during the survey (FIG. 2; David 1968, 1981) and three of these,
30 Nassarao, Douloumi and Bé, were subject to screened excavations and
31 radiometric dating. Unfortunately, most of the radiocarbon samples were
32 destroyed in transit from Cameroon to the USA (David 1968), so little is known
33 of the chronology of settlement in this area. Two radiocarbon ages analyzed
34 place the initial occupation of Douloumi at 538 ± 50 ^{14}C B.P. (505–650 CAL B.P.; P-
35 1764) and an occupation at Bé at 150 cm above the initial settlement of the
36 mound dated to 1061 ± 35 ^{14}C B.P. (930–1055 CAL B.P.; P-1767) (David 1981).
37 Subsistence foods were reported as including sorghum (*Sorghum* sp.), eleusine
38 (*Eleusine* sp.), cattle (*Bos taurus*), goats (*Capra hircus*) and various species of fish
39 (David 1981).

40 Cultural sequences from the Benue River Valley have not been examined
41 over the 35 years since David's (1981) work. Given this region's potentially
42 important role as a line of communication between the Niger River and Lake
43 Chad-Logone-Chari hydrographic systems, thus articulating riverine access
44 through much of West and Central Africa, its prehistoric chronology of human
45 settlement deserves more archaeological research. In this article, we present the
46 results of further research in the Middle Benue River Valley, focusing on
47 formation processes of one of the mounds bisected by an ephemeral stream. We
48 argue for purposeful aggradation of mound sediments at the site of Langui-
49 Tschéboua (GRA-4) in a relatively short time-span, possibly in an attempt to
50 elevate the settlement above the floodplain and to improve access to a diverse

array of resources within the two geomorphic zones. This sequence represents a significantly different formation process than the traditionally espoused model of slow aggradation through repeated occupation and housing melting (e.g., Friedel 1978; Van Beek and Van Beek 2013). Optimal settlement proximal to Vertisols that supported *karal* agriculture (a subsistence strategy still practiced in the region today) is hypothesized to be a crucial factor in the construction of anthropogenic mounds.

The Study Region

The project area is located in the Benue River Valley, which drains the Mandara Mountains to the north and the Adamawa Plateau to the south (FIG. 1). The Benue River forms the lowland trough of the Yola Rift, with headwaters originating more than 200 km to the south of the project area in the Adamawa Plateau. Two fluvial terraces were identified in the area directly east of the city of Garoua, one of which was partially flooded at the time of the investigation. The first terrace (T-1) is located at approximately 200 m.a.s.l. and is comprised of seasonally-inundated, clay-dominant sediments in strongly-developed Vertisol (clay-rich grassland) soils. The second terrace (T-2) crests approximately 5 m above the first terrace and is comprised of a sandier fraction (mostly well-sorted fine to medium sands); it is currently being episodically incised by secondary drainages feeding the Benue River. T-2 articulates into the pediment zone of the Fali Mountains that lie to the north of the floodplain, and is variably overlain by associated alluvial fan sediments with weak, lateritic soils that can generally be classified as Lixisols (FAO)/Alfisols (USDA). Laterites (FAO)/plinthites (USDA) typically form in subhumid tropical ecosystems in which native tree species have

76 been removed, mobilizing iron precipitates and indurating the subsoil.
77 Anthropogenic mounds were located along the Middle Benue River floodplain
78 and adjacent terraces (FIG. 2).

79 Throughout the Iron Age, sorghum and millet (*Pennisetum glaucum*) were
80 important staple crops of the inhabitants of the subhumid regions in the
81 southern Sahel where the Benue River is located (Kahlheber and Neumann
82 2007). Farming systems introduced during the Iron Age concentrated settlement
83 in the valley bottomlands of the Benue River, which remains the most densely
84 populated ecozone of the region as a whole. Today, the region is occupied by a
85 great diversity of ethnic groups. In precolonial times, this included a large
86 number of different farming populations (including the Fali, Mbum, Mambay,
87 Dama and Sara), as well as Islamic populations that included both pastoralists
88 (Fulani/Mbororo, along with some Shuwa Arabs), and farmers and traders
89 (Kanuri and Hausa) (Gauthier 1969). In the last half of the 20th century, the
90 availability of unclaimed land around the Benue Valley attracted immigrants
91 from other areas of northern Cameroon, increasing ethnic diversity still further.
92 The abundance of fertile soil and available water continues to draw people to the
93 region today.

94 The local farming economy engage in variants of *karal* agriculture, in
95 which *mouskwari* and related forms of sorghum are seasonally cultivated in the
96 dry soils during the rainy season, then transplanted to the clay-rich Vertisols
97 located on the lower aspects of the floodplain during the dry season (Kenga *et al.*
98 2003). Pastoralism and other extensive forms of land management switch
99 accordingly from flooded to dry landforms based on the *karal* rotation. This form

of economic diversification buffers subsistence systems against crop failures associated with extremes in precipitation availability.

Survey methods and results

Archaeological research undertaken northeast of Garoua, Cameroon in June and July 2014 was focused on locating and evaluating archaeological sites for longer-term research, and providing more detailed data for reconstructing Iron Age settlement of the region. (Our initial plan was to evaluate terrace systems in the Mandara Mountains further to the north in Cameroon (MacEachern 2012a, 2012b), but the Boko Haram insurgency directly across the border in Nigeria made that impossible.) The research project focused on revisiting an area of archaeological interest initially investigated by Nicholas David along the Benue River, and potentially adding more sites to the inventory that he produced. Documentation of site locations and attributes were made using a Trimble XH GPS unit.

David's (1981) map was georectified in ArcGIS 10.1 against satellite imagery and vector-based points were created in a database identifying the locations of mound sites. Nine archaeological sites in the Benue River floodplain were recorded, of which four sites were relocated from David's (1981) study (FIG. 2). Following the 2014 field season, buffers of 100 m, 200 m, 300 m and 500 m were created in ArcGIS around the T-1/T-2 interface in order to determine the numbers of sites that occur within each buffer. Based on the georectified image (and the four redundantly mapped sites from our field reconnaissance), six sites fall within 100 m, 12 within 200 m, 16 within 300 m

and 28 out of a total of 39 mound sites occur within 500 m of the T-1/T-2 interface.

Four of these sites are particularly worthy of attention in the context of the project objectives. Percussion auger samples of the sediments from T-1 and T-2 of each site were taken for geochemical and botanical analysis, which are presently in progress, but the focus of the present paper will be on formation processes of the Langui-Tchéboua mound and connections between past and present agricultural systems. Brief descriptions of the three largest sites follows.

Langui Tchéboua (GRA-4). Langui-Tchéboua is a mound feature bisected by the shifting course of the Mayo Badjouma seasonal stream (FIGS. 3, 4). It appears that the original elevated area of the mound was approximately 100 m in diameter, although cultural materials interpreted as secondary deposits were found protruding from the cut bank beyond that elevated area as well. The fluvial incision appears to have removed approximately half of the total area of the mound, leaving a flat scarp face, with continuous cultural deposits exposed to a depth of up to 5.4 m along the approximately 100 m of exposure. The mound unconformably articulates into an adjacent fluvial terrace, which is also exposed in section. Our research team took the opportunity to document the stratigraphy and soils and collect samples from three distinct areas of this site. A total of five sub-features were documented in the mound fill, including the remains of a pot burial eroding from near the base.

Bé. Originally documented by Nic David (1981), this site is comprised of a minimum 25 ha area that extends from a ~10 m high anthropogenic fill zone of definite archaeological provenience into the eponymous modern settlement, in which mound construction continues unabated by the modern inhabitants. All

portions of the mounds are currently under cultivation. One 2 m deep core was extracted 14.2 m NW of David's (1981) unit, and two 2-m deep percussion cores were extracted from the clayey sediments on the adjacent lower terrace floodplain, where seasonal floodplain (*karal*) sorghum farming is still taking place. Laminated clays within the cores extracted from T-1 are consistent with slackwater, overbank flooding and almost no sandy intraclasts were recorded in the sediments.

Loumbou (GRA-8). This site was originally mapped by Nic David (1981), but a detailed description was not made. Minimally measuring 20 ha, this site is also currently occupied and extensively farmed, and is positioned at the intersection of the upper and lower terraces of the Benue River. The anthropogenic fill provides relief to the site in relation to the lower terrace, and, as at Bé, a mixed regime of dry (upper terrace) and *karal* (lower terrace) agriculture is practiced today. This site warrants further investigation, with potentially equal stratigraphic complexity and cultural-historical significance to that of Langui-Tchéboua and Bé.

Langui-Tchéboua (GRA-4): Methods

Documentation.

Profiling and sampling of the Langui-Tchéboua mound and field site were undertaken by cleaning the scarp face with sharp tools sufficient to expose and systematically map the stratigraphic positions of soils and sediment fractions within the profile. Our team collected sediment samples for Optically Stimulated Luminescence (OSL) and charcoal for accelerator mass spectrometry radiocarbon (AMS ^{14}C) dating during the profiling. The mound was subjected to

three-dimensional mapping to record lateral and vertical distribution of material culture remains. Archaeological features were documented in the site fill, and lithological units traced across the site area and to the surrounding terrace surface exposures. Artifacts were not systematically collected, but were photographed and documented when disturbed from *in situ* contexts during profiling. Site documentation extended to the adjacent terrace regions to connect mound activity areas with possible concurrent agricultural activity areas.

Sampling.

Seven sediment samples were collected from the profile for OSL dating. OSL dating measures the last time that sand grains were exposed to light vis-à-vis the accumulation of beta radiation in the defects of the crystal matrix of minerals. Samples are collected in light-free containers and when extracted and exposed to light in controlled laboratory circumstances, accumulated electrons are counted in a photomultiplier tube later followed by experiments to reconstruct the time it took to accumulate the stored energy (a simplified explanation of the method can be found in Wright 2016).

For Langui-Tchéboua, quartz grains with diameters of 180-250 μm were prepared in the laboratory using wet sieving, acid treatments (10% HCl, 10% H_2O_2 and 40% HF) and density separation and were analyzed using a TL/OSL-DA-20 Risø reader. The Single Aliquot Regeneration (SAR) protocol (Murray and Wintle 2000; Murray and Wintle 2003) was followed. The measured equivalent dose (D_e), which is the reconstructed total amount of stored energy, was determined to be independent of the preheat temperatures between 250 and 295°C based on plateau tests (FIG. 6). Dose rates (D_r) of the samples, which are the rates of radioactive decay within the minerals' environment, were estimated

using a Canberra BEGe 5030 low-level high-resolution gamma spectrometer. OSL signals were measured based on aliquots composed of several tens of quartz grains (small aliquots), and the final ages were derived using the central age model (Galbraith and Roberts 2012; Galbraith *et al.* 1999a).

Undisturbed soil samples were also collected for micromorphological analysis. All water was removed from the samples through acetone exchange. The samples were then impregnated using polyester 'polylite 32032-00' resin. Impregnated soils were cured, and then sliced, bonded to a glass slide and precision lapped to 30µm thickness to produce a soil thin section. By following procedures laid out in the International Handbook for Thin Section Description (Bullock *et al.* 1985) and Stoops (2003), soil properties were recorded semi-quantitatively. The thin sections were analyzed using a Zeiss' AxioLab.A1 with rotary stage, plane polarised light (PPL), crossed polarized light (XPL) and oblique incident light (OIL). Each of these instruments allow identification of specific microscopic features, such as mineral and organic components, pedofeatures and burnt residues.

Langui-Tchéboua (GRA-4): Results

A total of five sub-features were documented in the Langui-Tchéboua mound fill, including the remains of a pot burial eroding from near the bottom of the mound (FIG. 4c). Sediments in the mound were primarily comprised of alternating lenses of poorly sorted sandy loam and loamy sand devoid of bedding structures. Clay-rich lenses in Units 12, 17 and 24 as well as ashy fill layers in Units 10, 12 (within the sandy clay loam matrix), 20, 26 and 28 indicate that the sources of anthropogenic fill were variable (FIG. 5). A full description of the

sedimentology of the mound fill and adjacent floodplain deposits are provided in Supplementary Material 1.

An OSL sample was analyzed from the burial sub-feature fill in order to constrain the early occupation of the site and yielded an age of 1100 ± 100 years (FIG. 5; TABLE 1). Radiocarbon ages on charcoal from the stratigraphic section with dates constrain ~ 1.5 m of primary mound fill as aggrading between 670-730 cal. B.P. (FIG. 5; TABLE 2), indicating rapid accumulation of mound sediments during this time. An OSL age at 900 ± 100 years from approximately 90 cm below the modern ground surface overlaps the radiocarbon chronology when factored to $2\text{-}\sigma$ (FIG. 5). Investigation of the adjacent exposed terraces showed that the floodplain deposits post-date habitation of the mound by more than 500 years. We infer that significant scouring and filling by fluvial channels in a dynamic floodplain environment have eroded Anthrosols from the Iron Age that may have existed south of the site.

Over-dispersion tendencies of OSL of small aliquots (Arnold and Roberts 2009) demonstrate centrality in dispersion and mixing thresholds below 35% (TABLE 1). Such distributions of data have been used to argue for sample efficacy and relatively low stratigraphic mixing of grains in a variety of depositional settings (Alexanderson and Murray 2007; Armitage and King 2013; Duller 2003; Forman 2015; Rowan *et al.* 2012). The highest over-dispersion measures from the project came from paleosols interpreted as anthropic in origin and likely had some degree of intentional mixing associated with plant cultivation, which was confirmed by micromorphological analysis of the soils (see below). The low over-dispersion (22.3%) for CAM-GRA14-OSL6 is consistent with alluvial sediments that underlie the primary mound, because the

measure is similar to the natural value of 17.4% taken from the channel bottom sediments for CAM-GRA14-OSL7. This could also account for the anomalous age (5800±400 years) of the sample, if it had not been subjected to solar reset.

Micromorphologic analysis of Langui-Tchéboua mound sediments demonstrates three primary taphonomic features of mound accumulation (TABLE 3). First, the primary occupation of the mound included small fragments of bone associated with Sub-feature 1, supporting the field interpretation of a burial feature (FIG. 7a). The sedimentology shows a clear stratigraphic unconformity consistent with an excavated pit. Second, there is little evidence for post-depositional mixing of sediments within the mound, and the strata are in their primary depositional aspect (FIG. 7a, b). Third, accumulation of the primary occupation of the site that occurred ca. 700 years ago was rapid, containing no evidence for burning, daub or other structural materials in the analyzed samples (FIG. 7b). Micromorphological sampling also appears to have not captured the charcoal present in the fill.

Although the adjacent terrace tested in 2014 post-dated the occupation of the mound by >500 years, the micromorphology informs land management from the last 140 years (TABLE 3). The evidence shows that some fields were burned with microscopic flecks of charcoal in the soil (MM3A, MM5), but another soil showed no evidence for agricultural activity (MM4) and may have been used more extensively by pastoralists. As is typical for floodplains, redoximorphic (iron-rich, water-logging) features in the sediments are indicative of fluctuating groundwater conditions (MM3, MM3A, MM4, MM5). Limited burrowing by microfauna also disturbed the primary depositional context, confirming the high over-dispersion results derived from OSL analysis.

274

275 **Discussion**

276 On the Langui-Tchéboua site in the Benue River floodplain, archaeological
277 settlement is recorded from the end of the first millennium A.D. and appears to
278 have focused on use of the upper to lower terrace ecotones for agricultural
279 purposes. A human burial excavated into the basal cultural fill zone at the site
280 was approximately 25 cm above the floodplain. Following initial site occupation,
281 rapid sedimentation of the mound feature is indicated by both radiometric ages
282 and micromorphology, suggesting an intent to raise the elevational aspect of the
283 site above the floodplain around 700 years ago. Unlike settlement mounds
284 documented in southwest Asia and Mesoamerica (e.g., Friedel 1978; Van Beek
285 and Van Beek 2013), at least a significant proportion of the cultural fill at Langui
286 Tchéboua was not the byproduct of incremental weathering, destruction and
287 reconstruction of habitation structures. Instead, much of the sediments on the
288 mound feature appear to have been dredged from adjacent alluvium, as is
289 indicated by the OSL age of sample CAM-GRA14-OSL6 (5800 ± 400 years),
290 corresponding very closely to the OSL age for the sandy substratum of the
291 mound (5900 ± 300 years; CAM-GRA14-OSL7). The CAM-GRA14-OSL6 sample is
292 interpreted as not having undergone solar reset during transport and deposition,
293 which probably occurred as basket fill. Although there may have been alternative
294 means of constructing the mound, the data suggest at least one episode of
295 deliberate and rapid accumulation of sediments above the floodplain.

296 The paired use of micromorphology and OSL as tools for understanding the
297 formation of anthropogenic landforms can provide archaeologists with
298 exceptional insights into the timing and methods associated with mound

construction. Selection of sampling locations differ for the two methods: OSL samples should normally only be collected from homogenous, non-pedogenic horizons with solid evidence for solar resetting prior to burial and micromorphological samples are best collected in heterogeneous depositional and/or pedogenic contexts. In some cases, OSL and micromorphological samples should be collected in tandem when depositional and/or taphonomic circumstances are enigmatic. In other West African Iron Age mound sites such as Gao Saney (Cissé *et al.* 2013) and Mouyssam II (Togola 1996), rapid formation processes are inferred from radiocarbon dates. However, radiocarbon ages do not date sediment deposition events and in the absence of datasets such as OSL or micromorphology that explain post-depositional disturbance agents, the mechanisms and trace inclusions associated with formation are not apparent.

Based on the results of David's (1968, 1981) survey, augmented with a better understanding of the formation processes associated with mound construction from Langui-Tchéboua and satellite reconnaissance of the Benue River Valley more broadly, the locations of Iron Age mounds appear to be situated to take advantage of variable resources within adjacent dryland and seasonally flooded landforms. Although it is not known whether the mound sites documented by David (1981) were occupied simultaneously, there appears to have been dense Iron Age settlement of the middle Benue River region, which would explain why local labor resources would be invested in situating a site in an optimal environmental context. This raises the question of placement of this region in a broader regional cultural history, a process that has at this point barely begun.

Early settlement of the Benue River Valley has been hypothesized to have been the result of migrations of Iron Age agro-pastoralists arriving from the north (David 1981). The different forms of roulettes and burnished red slips (FIG. 8) on surface ceramics examined during 2014 fieldwork are generally similar to pottery documented in the southern Lake Chad Basin (FIG. 9; MacEachern 2012b). The presence of the pot burial at Langui-Tchéboua (FIG. 4c), as well as what appears to be a Type 1 ceramic tamper used in pot-forming (FIG. 8d; Sterner and David 2003) on the surface at Bé, hitherto known only in the Lake Chad Basin, provide more specific northern links. Cultural developments in the southern Lake Chad Basin during the first millennium A.D. may have led to the spread of farming populations to the south (Magnavita *et al.* 2010). It is quite possible that one axis of such a population expansion would have been riverine populations moving down the Logone and from there into the Benue drainage and so to the survey area.

Conclusions

Iron Age habitation of the Middle Benue River region is identified initially in the form of a pot burial at the site of Langui-Tchéboua occurring 1100±100 years ago and then took the form of a rapid accumulation of sediments around 700 years ago. These ages are in general temporal agreement with David's (1981) report of Iron Age occupations at Douloumi (ca. 600 years ago) and Bé (ca. 1000 years ago). The degree to which the builders of these sites were ethnically and/or economically interrelated is difficult to ascertain at this point. However, the presence of similar pottery types at all locations studied implies that none of these settlements existed in isolation.

The rapid later-phase construction of Langui-Tchéboua challenges traditional understandings of mound sediment accumulation. Instead of being the byproduct of centuries or millennia of aggrading habitation debris, this mound appears to have been quickly, and presumably thus deliberately, raised above the floodplain. Distinct fill zones and cultural debris in the sediments attest to variable sources of materials besides sandy channel alluvium. Ultimately, the motivations behind this intentional building up of a mound are not known. However, the present-day *karal* crop rotation system of the region provides a reference point for understanding the value of flexible land management practices, which is supported by the more recent archaeological evidence from the floodplain deposits adjacent to the Langui-Tschéboua mound. Regional paleoclimatic reconstructions show variable precipitation during the early-/mid-first millennium B.P. related to the transition from the so-called Medieval Warm Period to the Little Ice Age (Maley and Vernet 2013, 2015).

Thus, the accumulation of the mound at the beginning of the Little Ice Age, probably associated with lake-level increases and riverine flooding, may be a cultural response to maintain productive *karal* (or precedent) farming within a fluctuating ecosystem. At the very least, mounded locations overlooking floodplains provided a wide range of economic opportunities, from fishing to pastoralism to diverse modes of agriculture and foraging, as evidenced in the archaeological data recovered by David (1968, 1981). Strategic mound settlement in relation to diverse resource bases have been identified elsewhere in western Africa (Connah 1981; Höhn and Neumann 2012; Holl *et al.* 1991; Klee and Zach 1999; Van Neer 2008), but the formation model of Langui-Tchéboua presented in this paper using multiple sedimentological proxies highlights

purposefulness in the creation of mound features that involved mobilization of large amounts of labor for some perceived economic or social benefit.

The Iron Age in western Africa is characterized by the evolution of greater social interconnections, agricultural intensification associated with population increases and forms of political complexity to manage these systems (MacEachern 2005; McIntosh 1999). The Middle Benue River Valley was clearly a component of this wider system and warrants significantly more research than it has received. The density and diversity of settlements suggest the presence of large prehistoric populations engaged in variable economic activities (see also David 1981). We look forward to undertaking more research along the Middle Benue, to further elucidate the trajectory of settlement patterning, economic change and political developments in this fascinating region.

Acknowledgments

Permission to conduct this research project was granted by Ministère de la Recherche Scientifique et de l'Innovation in Cameroon. A National Geographic Committee for Research and Exploration grant (9404-13) and Seoul National University faculty research grant funded the fieldwork and sample analyses. The write-up of this work was supported by 'Overseas Training Expenses for Humanities' through College of Humanities Seoul National University (SNU). We would particularly like to thank the Lamido of Bé, Abdurahman Aman Saly, and the Lawan of Langui for their assistance and support. We would also like to thank our field assistants Kankaou Dirna and Haman Oumarou for help in preparing the sections for profiling at Langui-Tchéboua. George MacLeod at the University of Stirling, Scotland, prepared the thin sections for

397 micromorphological analysis. Seoyoung Huh at the Korea Basic Science Institute
398 assisted in preparing and running the OSL samples.

399 References

- 400 Albert, Klaus-Dieter, Maya Hallier, Stefanie Kahlheber, and Christoph Pelzer.
 401 2000. "Montee et abandon des collines d'occupation de l'age de fer au
 402 nord du Burkina Faso," *Berichte des Sonderforschungsbereichs* 268 (4): 18.
 403 Alexanderson, H., and A. S. Murray. 2007. "Was southern Sweden ice free at 19-
 404 25 ka, or were the post LGM glacifluvial sediments incompletely
 405 bleached?," *Quaternary Geochronology* 2 (1-4): 229-236.
 406 Armitage, S. J., and G. E. King. 2013. "Optically stimulated luminescence dating of
 407 hearths from the Fazzan Basin, Libya: A tool for determining the timing
 408 and pattern of Holocene occupation of the Sahara," *Quaternary*
 409 *Geochronology* 15: 88-97.
 410 Arnold, L. J., and R. G. Roberts. 2009. "Stochastic modelling of multi-grain
 411 equivalent dose (De) distributions: Implications for OSL dating of
 412 sediment mixtures," *Quaternary Geochronology* 4 (3): 204-230.
 413 Bullock, P., N. Federoff, A. Jongerius, G. Stoops, T. Turina, and U. Babel. 1985.
 414 *Handbook for Soil Thin Section Description*. Wolverhampton, United
 415 Kingdom: Waine Research Publications.
 416 Cissé, M., Susan K. McIntosh, L. Dussubieux, Thomas Fenn, Daphne Gallagher, and
 417 A. Chipps Smith. 2013. "Excavations at Gao Saney: New Evidence for
 418 Settlement Growth, Trade, and Interaction on the Niger Bend in the First
 419 Millennium CE," *Journal of African Archaeology* 11 (1): 9-37.
 420 Connah, Graham. 1981. *Three thousand years in Africa: man and his environment*
 421 *in the Lake Chad region of Nigeria*. Cambridge: Cambridge University
 422 Press.
 423 David, Nicholas. 1968. "Archaeological reconnaissance in Cameroon," *Expedition*
 424 10 (3): 21-31.
 425 David, Nicholas. 1981. "The archaeological background of Cameroonian history,"
 426 in C. Tardits, ed., *Contribution de la recherche ethnologique a l'histoire des*
 427 *civilisations du Cameroun*. Paris: Editions du CNRS, 79-98.
 428 Duller, G. A. T. 2003. "Distinguishing quartz and feldspar in single grain
 429 luminescence measurements," *Radiation Measurements* 37 (2): 161-165.
 430 Filipowiak, W. 1979. *Etudes archéologiques sur la capitale médiévale du Mali*.
 431 Szczecin: Muzeum Narodowe.
 432 Forman, Steven L. 2015. "Episodic eolian sand deposition in the past 4000 years
 433 in Cape Cod National Seashore, Massachusetts, USA in response to
 434 possible hurricane/storm and anthropogenic disturbances," *Frontiers in*
 435 *Earth Science* 3: <http://dx.doi.org/10.3389/feart.2015.00003>.
 436 Friedel, David. 1978. "Maritime adaptation and the rise of Maya civilization: The
 437 view from Cerros, Belize," in B. L. Stark and B. Voorhies, eds., *Prehistoric*
 438 *Coastal Adaptations: The Economy and Ecology of Maritime Middle*
 439 *America*. New York: Academic Press, 239-266.
 440 Gado, Boubé. 1993. "Un "Village des morts" à Bura en république du Niger," in J.
 441 Dviesse, ed., *Vallées du Niger*. Paris: Réunion des Musées Nationaux, 365-
 442 374.
 443 Gado, Boubé. 2004. "Les systèmes des sites à statuaire en terre cuite et en pierre
 444 dans la vallée du moyen-Niger entre le Gorouol et la Mékrou," in A.
 445 Bazzana and H. Bocoum, eds., *Du Nord au Sud du Sahara : 50 ans*

446 *d'archéologie française en Afrique de l'Ouest et au Maghreb*. Paris: Sépia,
447 154-181.

448 Galbraith, R. F., and R. G. Roberts. 2012. "Statistical aspects of equivalent dose
449 and error calculation and display in OSL dating: An overview and some
450 recommendations," *Quaternary Geochronology* 11: 1-27.

451 Galbraith, R. F., R. G. Roberts, G. M. Laslett, H. Yoshida, and J. M. Olley. 1999a.
452 "Optical dating of single and multiple grains of quartz from jinnium rock
453 shelter, northern Australia, part 1, Experimental design and statistical
454 models," *Archaeometry* 41 (2): 339-364.

455 Galbraith, R. F., R. G. Roberts, G. M. Laslett, H. Yoshida, and J. M. Olley. 1999b.
456 "Optical dating of single and multiple grains of quartz from Jinmium rock
457 shelter, northern Australia: Part I, Experimental design and statistical
458 models," *Archaeometry* 41 (2): 339-364.

459 Gauthier, J.-G. 1969. *Les Fali de Ngoutchoumi: montagnards du Nord-Cameroun*.
460 Ossterhout: Anthropological Publications.

461 Höhn, Alexa, and Katharina Neumann. 2012. "Shifting cultivation and the
462 development of a cultural landscape during the Iron Age (0–1500 AD) in
463 the northern Sahel of Burkina Faso, West Africa: Insights from
464 archaeological charcoal," *Quaternary International* 249 (0): 72-83.

465 Holl, Augustin F. C. 2002. *The Land of Houlof: Genesis of a Chadic Polity 1900 BC -*
466 *AD 1800, Memoirs of the Museum of Anthropology, University of Michigan*
467 35. Ann Arbor: Museum of Anthropology, University of Michigan.

468 Holl, Augustin F. C. 2014. *Archaeology of Mound-Clusters in West Africa*. L. Smith,
469 B. Stewart and S. Wynne-Jones, *Cambridge Monographs in African*
470 *Archaeology* 77. Oxford: Archaeopress. BAR International Series 2660.

471 Holl, Augustin, Claude Lechevalier, Anne Bridault, and Thomas E. Levy. 1991. "Of
472 men, mounds and cattle: archaeology and ethnoarchaeology in the
473 Houlof region (Northern Cameroon)," *West African Journal of*
474 *Archaeology* 21: 7-36.

475 Kahlheber, Stefanie, and Katharina Neumann. 2007. "The development of plant
476 cultivation in semi-arid West Africa," in T. P. Denham, J. Iriarte and L.
477 Vrydaghs, eds., *Rethinking agriculture: archaeological and*
478 *ethnoarchaeological perspectives*. Walnut Creek, California: Left Coast
479 Press, 320-346.

480 Kenga, Richard, Mathurin M'Biandoun, Aboubakar Njoya, Michel Havard, and
481 Eric Vall. 2003. "Analysis of constraints to agricultural production in the
482 Sudan-sahelian zone of Cameroon using a diagnostic survey," Paper read
483 at Savanes africaines : des espaces en mutation, des acteurs face à de
484 nouveaux défis., at Garoua, Cameroon.

485 Klee, Marlies , and Barbara Zach. 1999. "The exploitation of wild and
486 domesticated food plants at settlement mounds in north-east Nigeria
487 (1800 cal BC to today)," in M. van der Veen, ed., *The exploitation of plant*
488 *resources in ancient Africa*. New York: Kluwer Academic/Plenum
489 Publishers, 81-88.

490 MacEachern, Scott. 2005. "Two thousand years of West African history," in A.
491 Stahl, ed., *African archaeology: a critical introduction*. London: Blackwell,
492 441-466.

- 493 MacEachern, Scott. 2012a. "The Holocene history of the southern Lake Chad
494 Basin: archaeological, linguistic and genetic evidence," *African*
495 *Archaeological Review*: 1-19.
- 496 MacEachern, Scott. 2012b. "The prehistory and early history of the northern
497 Mandara Mountains and surrounding plains," in N. David, ed., *Metals in*
498 *Mandara Mountains' society and culture*. Trenton, NJ: Red Sea Press, 29-
499 67.
- 500 Magnavita, Carlos, Peter Breunig, Daniel Ishaya, and Olusegun Adebayo. 2010.
501 "Iron Age beginnings at the southwestern margins of Lake Chad," in S.
502 Magnavita, L. Koté, P. Breunig and O. Idé, eds., *Crossroads/Carrefour Sahel.*
503 *Cultural developments and technological innovations in 1st millennium*
504 *BC/AD West Africa*. Frankfurt: Journal of African Archaeology Monograph
505 Series, 27-58.
- 506 Maley, Jean, and Robert Vernet. 2013. "Peuples et évolution climatique en
507 Afrique nord-tropicale, de la fin du Néolithique à l'aube de l'époque
508 moderne," *Histoire et archéologie du Sahel ancien : nouveaux regards,*
509 *nouveaux chantiers* 4: 50.
- 510 Maley, Jean, and Robert Vernet. 2015. "Populations and Climatic Evolution in
511 North Tropical Africa from the End of the Neolithic to the Dawn of the
512 Modern Era," *African Archaeological Review* 32 (2): 179-232.
- 513 Mayor, Anne, Eric Huysecom, Alain Gallay, M. Rasse, and A. Ballouche. 2005.
514 "Population dynamics and paleoclimate over the past 3000 years in the
515 Dogon Country, Mali," *Journal of Anthropological Archaeology* 24: 25-61.
- 516 McIntosh, Roderick J. 2005. *Ancient Middle Niger : urbanism and the self-*
517 *organizing landscape*. Cambridge, UK; New York: Cambridge University
518 Press.
- 519 McIntosh, Roderick J., and Susan Keech McIntosh. 1981. "The inland Niger delta
520 before the empire of Mali: evidence from Jenne-Jeno," *Journal of African*
521 *history* 22 (1): 1-22.
- 522 McIntosh, Roderick J., Susan Keech McIntosh, and Hamady Bocoum, eds. 2015.
523 *The Search for Takrur: Archaeological Excavations and Reconnaissance*
524 *along the Middle Senegal Valley*. New Haven, Connecticut: Yale University
525 Press.
- 526 McIntosh, Susan Keech. 1995. *Excavations at Jenné-Jeno, Hambarketolo and*
527 *Kaniana (Inland Niger Delta, Mali), the 1981 season*. Vol. 20, *University of*
528 *California Publications in Anthropology*. Berkeley: University of California
529 Press.
- 530 McIntosh, Susan Keech. 1999. "Floodplains and the development of complex
531 society: Comparative perspectives from the West African semi-arid
532 tropics," *Archeological Papers of the American Anthropological Association*
533 9 (1): 151-165.
- 534 McIntosh, Susan Keech, Roderick J. McIntosh, and Hamady Bocoum. 1992. "The
535 Middle Senegal Valley Project: preliminary results from the 1990-91 field
536 season," *Nyame Akuma* 38: 47-61.
- 537 Monroe, James Cameron. 2014. *The Precolonial State in West Africa: Building*
538 *Power in Dahomey*. New York: Cambridge University Press.
- 539 Murray, A. S., and A. G. Wintle. 2000. "Luminescence dating of quartz using an
540 improved single-aliquot regenerative-dose protocol," *Radiation*
541 *Measurements* 32 (1): 57-73.

- 542 Murray, Ann S., and Ann G. Wintle. 2003. "The single aliquot regenerative dose
543 protocol: Potential for improvements in reliability," *Radiation*
544 *Measurements* 37 (4-5): 377-381.
- 545 Neumann, Katharina, Peter Breunig, and Stefanie Kahlheber. 2001. "Early food
546 production in the Sahel of Burkina Faso," *Berichte des*
547 *Sonderforschungsbereichs* 268 14: 327-334.
- 548 Ogundiran, Akinwumi. 2002. "Filling a gap in the Ife-Benin interaction field
549 (thirteenth - sixteenth centuries AD): excavations in Iloyi Settlement,
550 Ijesaland," *African Archaeological Review* 19 (1): 27-60.
- 551 Olley, Jon M., Andrew Murray, and Richard G. Roberts. 1996. "The effects of
552 disequilibria in the uranium and thorium decay chains on burial dose
553 rates in fluvial sediments," *Quaternary Science Reviews* 15 (7): 751-760.
- 554 Prescott, J. R., and J. T. Hutton. 1994. "Cosmic ray contributions to dose rates for
555 luminescence and ESR dating: Large depths and long-term time
556 variations," *Radiation Measurements* 23 (2/3): 497-500.
- 557 Raimbault, Michel, and Klèna Sanogo, eds. 1991. *Recherches archéologiques au*
558 *Mali: les sites protohistoriques de la zone lacustre*. Paris: Karthala.
- 559 Reimer, Paula J, Edouard Bard, Alex Bayliss, J Warren Beck, Paul G Blackwell,
560 Christopher Bronk Ramsey, Caitlin E Buck, Hai Cheng, R Lawrence
561 Edwards, Michael Friedrich, Pieter M Grootes, Thomas P Guilderson,
562 Hafliði Hafliðason, Irka Hajdas, Christine Hatté, Timothy J Heaton, Dirk L
563 Hoffmann, Alan G Hogg, Konrad A Hughen, K Felix Kaiser, Bernd Kromer,
564 Sturt W Manning, Mu Niu, Ron W Reimer, David A Richards, E Marian
565 Scott, John R Southon, Richard A Staff, Christian S M Turney, and Johannes
566 van der Plicht. 2013. "IntCal13 and Marine13 Radiocarbon Age
567 Calibration Curves 0–50,000 Years cal BP," *Radiocarbon* 55 (4): 1869-
568 1887.
- 569 Rowan, A. V., H. M. Roberts, M. A. Jones, G. A. T. Duller, S. J. Covey-Crump, and S.
570 H. Brocklehurst. 2012. "Optically stimulated luminescence dating of
571 glaciofluvial sediments on the Canterbury Plains, South Island, New
572 Zealand," *Quaternary Geochronology* 8 (1): 10-22.
- 573 Schoeneberger, P. J., D. A. Wysocki, E. C. Benham, and Soil Survey Staff. 2012. *The*
574 *Field Book for Describing and Sampling Soils, Version 3.0*. Lincoln,
575 Nebraska: Natural Resources Conservation Service, National Soil Survey
576 Center.
- 577 Sterner, Judith, and Nicholas David. 2003. "Action on matter: the history of the
578 uniquely African tamper and concave anvil pot-forming technique,"
579 *Journal of African Archaeology* 1 (1): 3-38.
- 580 Stoops, G. 2003. *Guidelines for analysis and description of soil and regolith thin*
581 *sections*. Madison, Wisconsin: Soil Science Society of America, Inc.
- 582 Togola, Téréba. 1996. "Iron Age occupation in the Méma region, Mali," *African*
583 *Archaeological Review* 13 (2): 91-110.
- 584 Van Beek, Gus W, and Ora Van Beek. 2013. *Glorious Mud!: Ancient and*
585 *Contemporary Earthen Design and Construction in North Africa, Western*
586 *Europe, the Near East, and Southwest Asia*. Washington, D.C.: Smithsonian
587 Institution.
- 588 Van Neer, Willem. 2008. "Fishing in the Senegal River during the Iron Age: The
589 evidence from the habitation mounds of Cubalel and Siouré," in S.
590 Badenhorst, P. Mitchell and J. Driver, eds., *Animals and People*:

591 *Archaeozoological Papers in Honour of Ina Plug*. Oxford: Archaeopress.
592 BAR International Series 1849, 117-130.
593 Wright, David K. 2016. "Other radiometric dating techniques (within Chapter 5:
594 Ecofacts and related studies)," in A. L. Smith, E. Cornelissen, O. Gosselain
595 and S. MacEachern, eds., *Field Manual for African Archaeology/Manuel de*
596 *Terrain en Archéologie Africaine*. Brussels: Royal Museum for Central
597 Africa, 35-40.
598

Figures

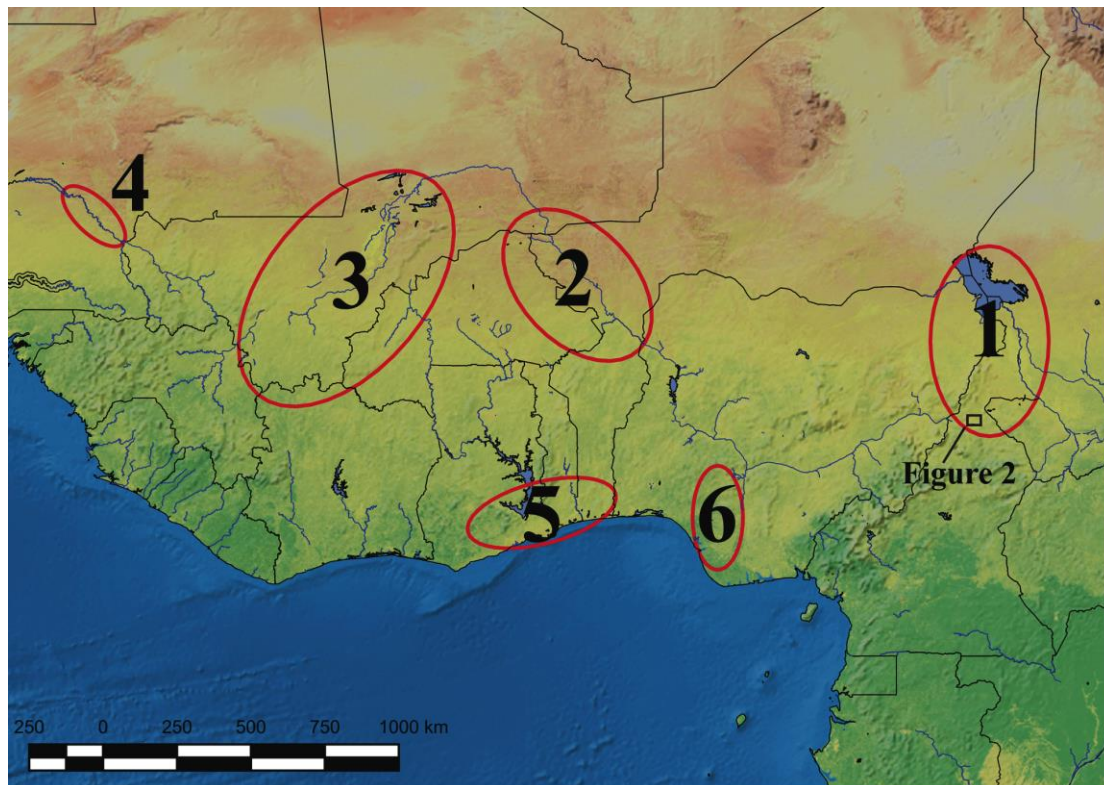


Figure 1 Location of mound sites across western Africa. (1) Lake Chad Basin and Benue Valley (Connah 1981; David 1968, 1981; Holl 2002; MacEachern 2012a); (2) Middle Niger River Valley and Oudalan Province (Albert *et al.* 2000; Cissé *et al.* 2013; Gado 1993, 2004; Mayor *et al.* 2005; Neumann *et al.* 2001); (3) Inland and Upper Niger and Mouhoun Bend (Filipowiak 1979; Holl 2014; McIntosh 2005; McIntosh and McIntosh 1981; McIntosh 1995; Raimbault and Sanogo 1991; Togola 1996); (4) Middle Senegal River Valley (McIntosh *et al.* 2015; McIntosh 1999; McIntosh *et al.* 1992; Van Neer 2008); (5) coastal Ghana-Togo-Benin (Monroe 2014); (6) Ife-Benin (Ogundiran 2002).

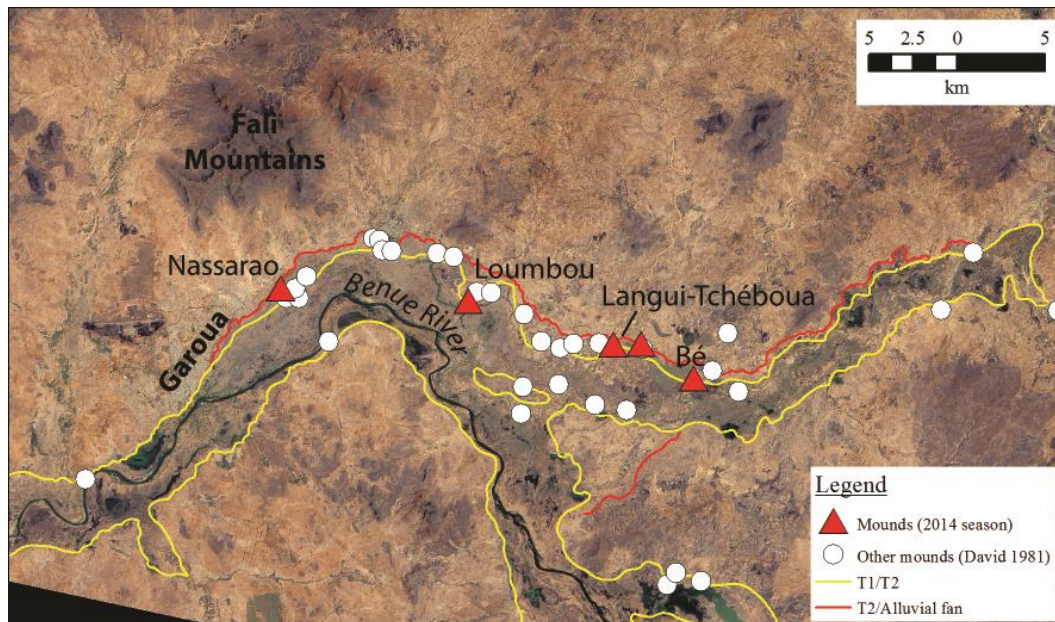


Figure 2 Project area showing locations of sites mentioned in the text. Landsat 8 satellite image downloaded from USGS (<http://earthexplorer.usgs.gov>). Mound locations plotted from georectified image (David 1981: Map 1).

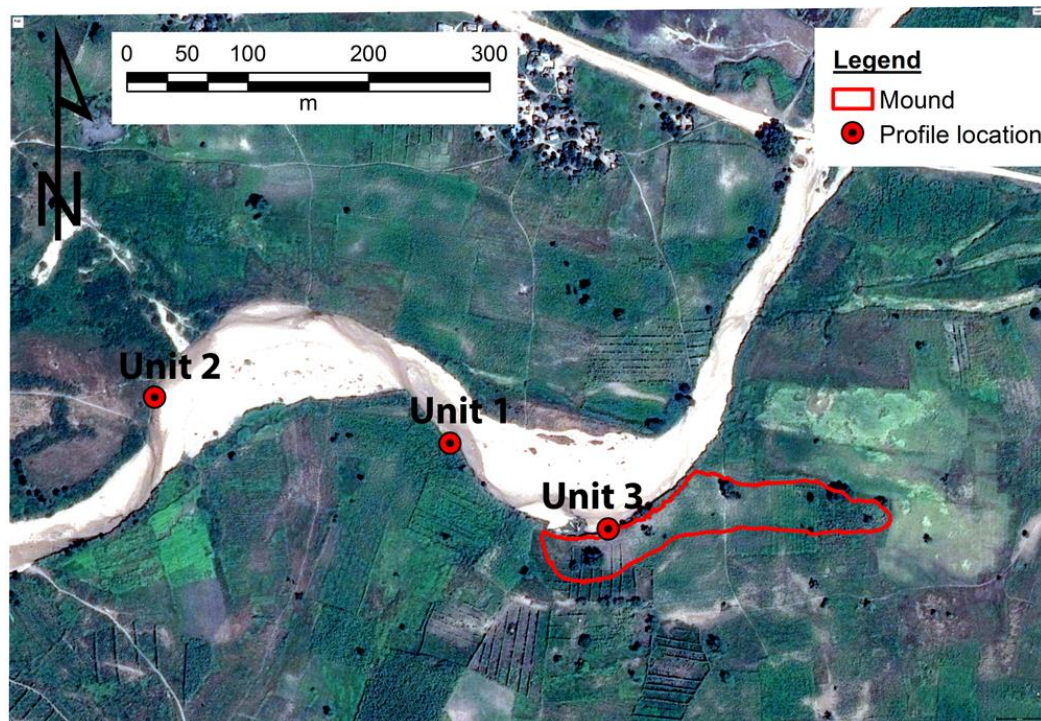


Figure 3 Plan map of Langui-Tchéboua.

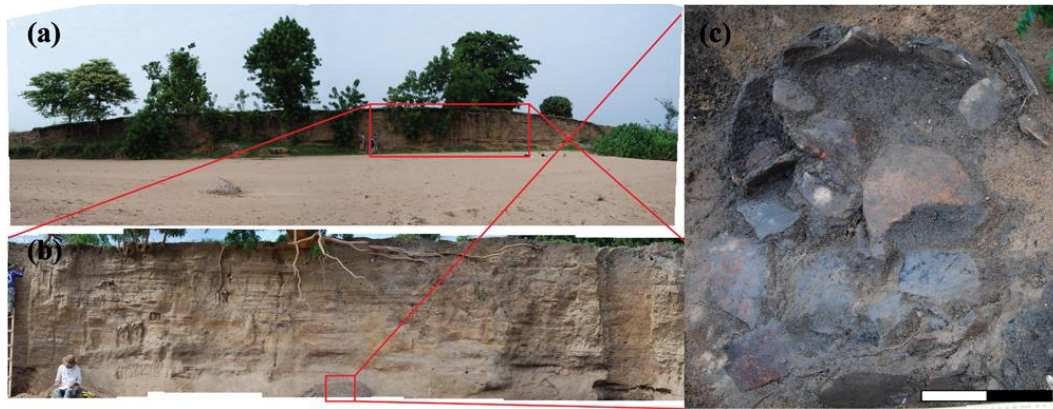


Figure 4 Photos of Langui-Tchéboua. (a) View of Feature 1 (mound) looking south; (b) Close view of mound sediments with profiled (Unit 3) on the far left; (c) Close up of pot burial with 20-cm scale.

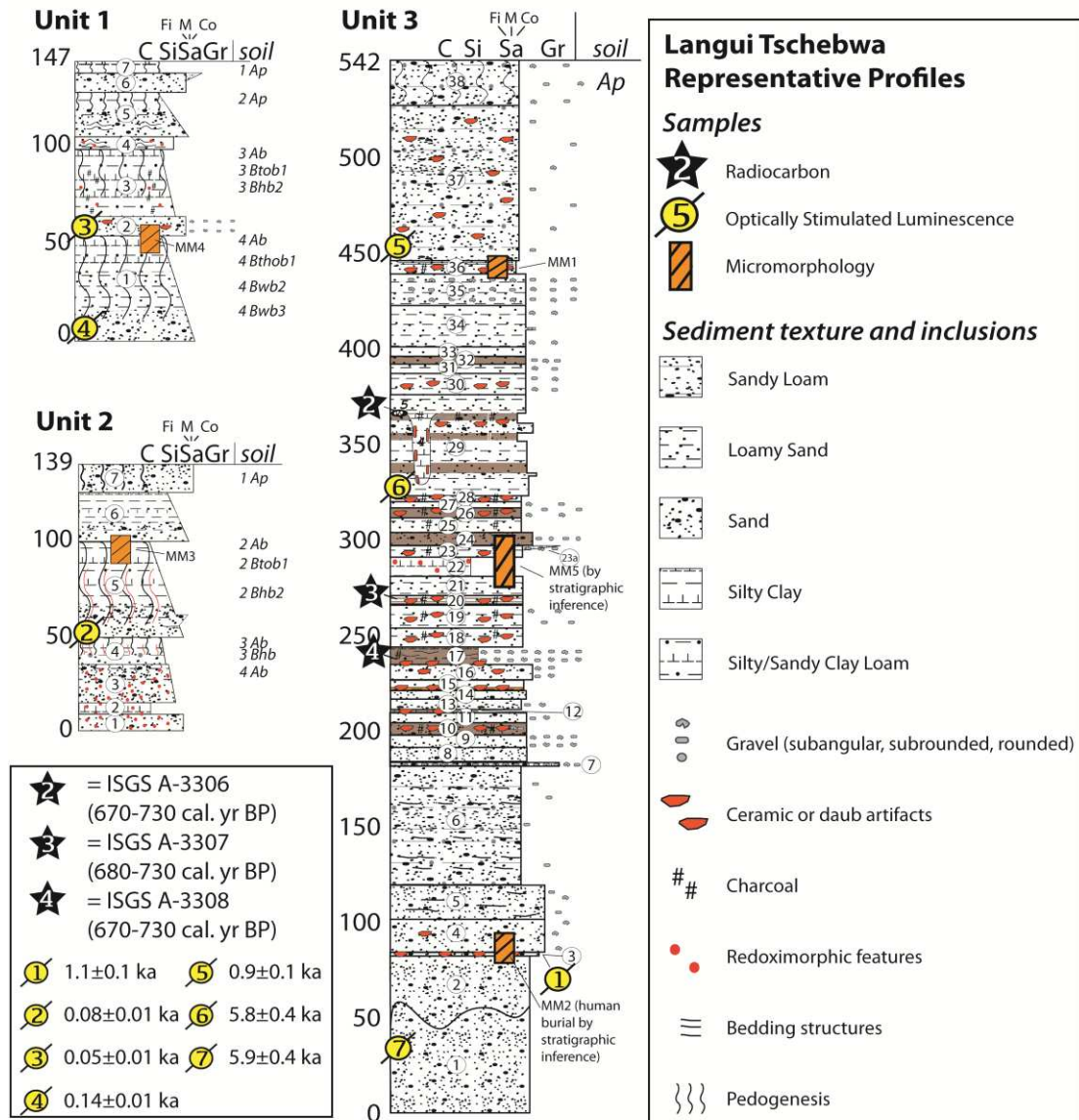


Figure 5 Preheat tests from CAM-GRA14-OSL3 and CAM-GRA14-OSL7. Relative proportions of clay (C), silt (Si), Sand (Sa, separated into Fine, Medium and Coarse fraction) and gravel (Gr) are shown for each test unit. Soil formation properties and pedofeatures are classified according to Schoeneberger *et al.* (2012).

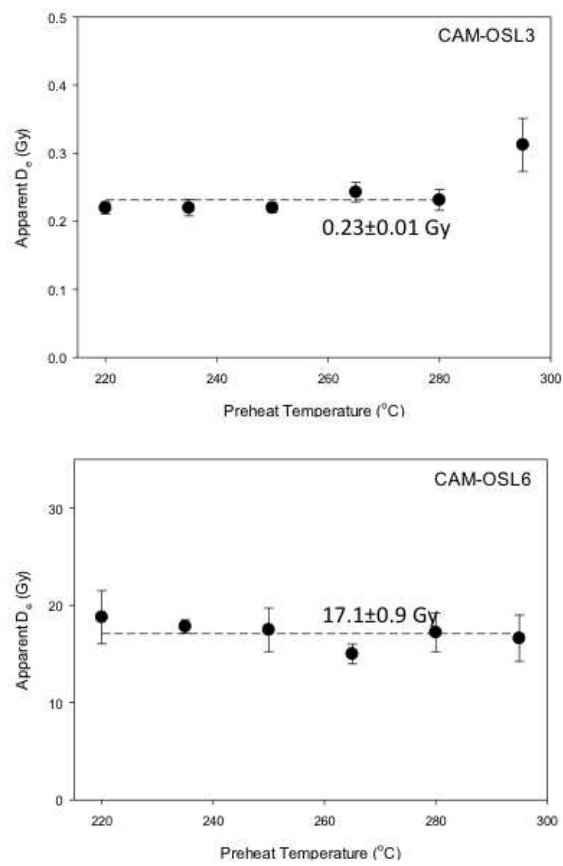


Figure 6 Profile of Langui-Tchéboua and adjacent fields showing sampling locations.

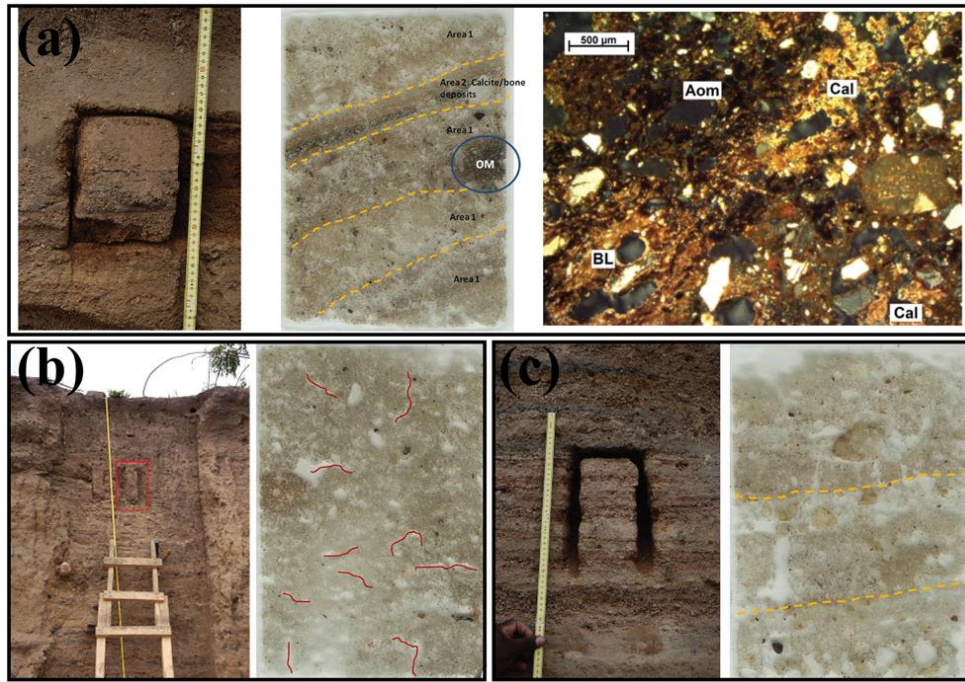


Figure 7 Location of the undisturbed soil samples with soil thin sections and micrograph: (a) Sub-feature 3 (burial) displayed alternating micro-laminations, Area 1 with organic matter (OM) and Area 2 containing calcitic bone deposits, the micrograph displaying bone (BL), calcitic intercalations and coatings (Cal) and amorphous organic matter (Aom) identified in cross-polarized light (XPL); (b) Aggraded sediments in Unit 3, Feature 1 exhibiting a weakly developed microstructure in soil thin section; (c) Easily identified micro-lamination at the sample site and weakly defined micro-laminations in the soil thin section.

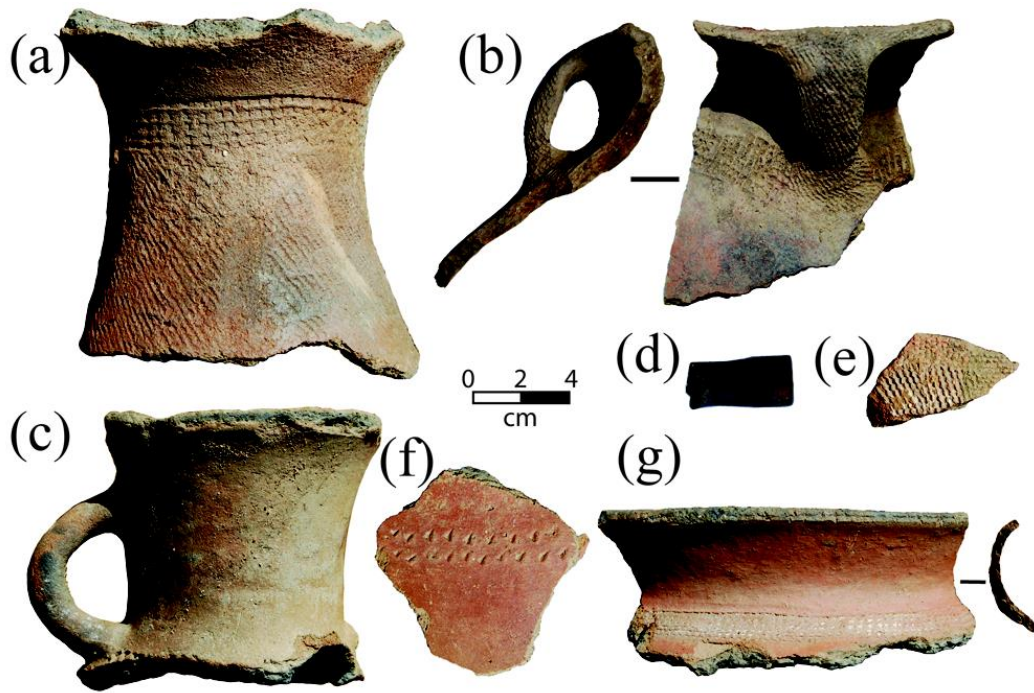


Figure 8 Selected ceramics from Langui-Tchéboua. (a) Cord-marked jar neck, with a band of comb-stamping; (b) jar rim with lug handle, with braided-strip roulette on handle and comb-stamped band on body; (c) bottle neck and rim with lug handle, with punctate design at the base of the neck; (d) incised pipe stem, possibly burnished, with multiple incised lines around circumference; (e) braided-strip roulette decorated body sherd; (f) body sherd with a linear punctate design; (g) comb-stamped neck and rim of a jar.

*NOTE: This image looks much darker when pasted into the word processing document than the original tiff.

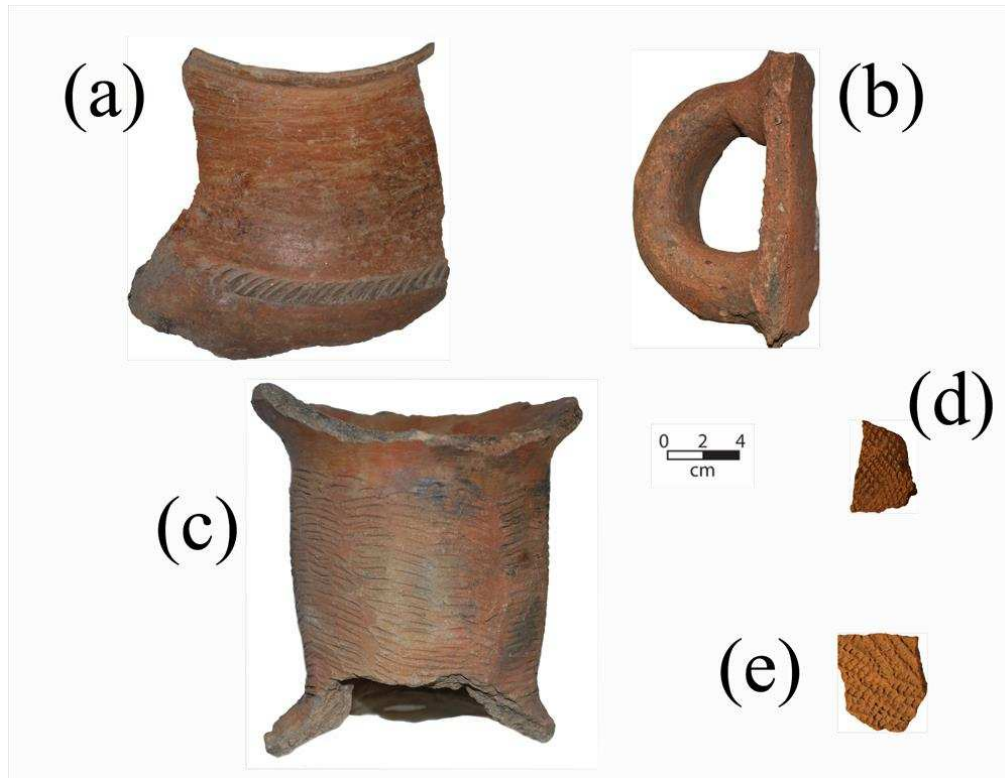


Figure 9 Ceramics from the southern Lake Chad Basin, with similar decorative styles to Benue ceramics (FIG. 8). Originating sites: (a), (b) and (d) Ghwa Kiva (PMW-744); (c) Liga SW (PMW-710); (e) Dugjé Gaya (PMW-761).

Tables

Table 1 Equivalent dose, dose rate and OSL ages of samples from Langui-Tschéboua, Cameroon

Sample	Depth* (cm)	Water content [†] (wt. %)	²³⁸ U (Bq·kg ⁻¹)	²²⁶ Ra (Bq·kg ⁻¹)	²³² Th (Bq·kg ⁻¹)	⁴⁰ K (Bq·kg ⁻¹)	Dry beta [‡] (Gy·ka ⁻¹)	Dry gamma [§] (Gy·ka ⁻¹)	Cosmic ray ^{**} (Gy·ka ⁻¹)	Total dose rate (Gy·ka ⁻¹)	D _e (Gy)	<i>n</i>	Over- dispersion (OD) % ^c	Age ^{††} (ka)	Context
CAM-GRA-14-OSL1	410	1.3	10.9±3.3	11.0±0.4	20.8±1.2	776±16	2.14±0.08	0.95±0.02	0.10±0.01	3.14±0.08	3.3±0.2	24	23.3	1.1±0.1	Human burial fill
CAM-GRA-14-OSL2	88	15.5	21.1±6.2	18.6±0.6	65.8±1.6	1075±22	3.26±0.12	1.79±0.03	0.18±0.02	4.43±0.11	0.36±0.03	21	30.4	0.08±0.01	Fluvial terrace
CAM-GRA-14-OSL3	86	1.6	12.8±5.5	14.2±0.6	35.0±1.5	1283±23	3.50±0.13	1.55±0.03	0.18±0.02	5.14±0.13	0.23±0.01	20	9.0	0.05±0.01	Fluvial terrace
CAM-GRA-14-OSL4	147	8.1	7.8±3.4	7.0±0.4	16.3±1.1	967±20	2.55±0.10	1.02±0.02	0.16±0.02	3.41±0.09	0.49±0.04	22	35.3	0.14±0.01	Fluvial terrace
CAM-GRA-14-OSL5	96	3.0	18.9±5.9	18.8±0.5	34.3±1.5	869±17	2.52±0.10	1.24±0.02	0.18±0.02	3.81±0.10	3.5±0.2	22	23.2	0.9±0.1	Mound sediment
CAM-GRA-14-OSL6	221	1.8	9.5±3.7	10.9±0.5	17.9±1.2	719±17	1.98±0.08	0.87±0.02	0.14±0.01	2.93±0.08	17.1±0.9	23	22.3	5.8±0.4	Mound sediment
CAM-GRA-14-OSL7	511	13.5	7.4±3.0	8.4±0.4	14.9±1.0	607±14	1.66±0.07	0.72±0.02	0.09±0.01	2.14±0.06	12.6±0.6	24	17.4	5.9±0.3	Fluvial terrace

* Depths of the samples are the vertical distance from the modern ground surface.

† Present water content.

‡ Data from high-resolution low level gamma spectrometer were converted to infinite matrix dose rates using conversion factors given in Olley *et al.* (1996).

§ Cosmic ray dose rates were calculated using the equations provided by Prescott and Hutton (1994).

** Over-dispersion calculated according to Galbraith *et al.* (1999b)

†† Central age (±1-σ error).

Table 2 Radiocarbon ages from Langui-Tchéboua.

Sample (ISGS #)	Depth (cm)	Material	$\delta^{13}\text{C}$	Fraction MC	\pm	$\Delta^{14}\text{C}$	\pm	^{14}C B.P.	cal. B.P. ^{*,†}	Context
A-3306	189	charcoal	-10.9	0.9091	0.0019	-90.9	1.9	765±20	670-730	Mound sediment
A-3307	270	charcoal	-25.4	0.9070	0.0018	-93.0	1.8	785±20	680-730	Mound sediment
A-3308	307	charcoal	-22.6	0.9074	0.0023	-92.6	2.3	780±25	670-730	Mound sediment

* Radiocarbon ages calibrated using CALIB 7.1 (Reimer *et al.* 2013)

† Ages $\pm 2\text{-}\sigma$ error

Table 3 Summary of micromorphological analysis.

Thin Section	Related distribution	c/f (50 μ m) distribution (ratio)*	Coarse material*		Limpidity/ <i>b</i> - fabric	Microstructure	Pedofeatures
			Mineral	Organic			
MM1	Chitonic	2:3	Quartz (50%), Plagioclase (10%), Microcline (5%), Feldspar (5%)	Plant (5%), Charcoal (5%)	Cloudy/speckled	Channel	Irregular shaped aggregate redoximorphic nodules in the fine matrix (50-1000 μ m).
MM2							
<i>Area 1</i>	Chitonic	2:3	Quartz (50%), Plagioclase 30%), Microcline (10%), Feldspar (10%), Quartzite (5%), Hornblende (2%)	Plant (5%), Charcoal (5%), Bone (2%)	Dotted/grano-, poro- and partial striations	Channel	Typic and aggregate redoximorphic nodules (5%) in the fine matrix, with calcite coatings (5%) on the surface of the channel voids (looks like link coatings).
<i>Area 2</i>	Gefuric	3:2	Quartz (50%), Plagioclase 30%), Microcline (10%), Feldspar (10%), Quartzite (5%), Hornblende (2%)		Dotted/ speckled	Channel/chamber	Calcite coatings (5%) within the vughs and chamber voids.
MM3							
<i>Area 1</i>	Enaulic	1:4	Quartz (50%), Plagioclase (10%), Microcline (5%)	Plant (5%), Charcoal (10%)	Dotted/speckled	Channel/chamber	Typic redoximorphic nodules located in the fine material (5%). Hypo-coatings around the edges of thee sub-angular peds.
<i>Area 2</i>	Chitonic	7:3	Quartz (50%), Plagioclase (10%), Microcline (5%), Feldspar (5%)	Charcoal (5%)	Dotted/speckled	Granular	Dense, complete infillings
MM3A							
<i>Area 1</i>	Enaulic	7:3	Quartz (50%), Plagioclase 30%), Microcline (10%), Feldspar (5%)	Plant (2%), Charcoal (5%)	Dotted/speckled and partial striations	Channel/chamber	Typic redoximorphic nodules in the fine matrix (2%).
<i>Area 2</i>	Chitonic	1:4	Quartz (50%), Plagioclase (10%),	Charcoal (5%)	Dotted/speckled	Channel	Hypo-coatings formed at the edges of the sub-angular peds
<i>Area 3</i>	Chitonic	1:4	Quartz (50%), Plagioclase (10%),		Dotted/speckled	Granular	Typic redoximorphic nodules in the fine matrix (2%).
MM4							
<i>Area 1</i>	Chitonic	4:1	Quartz (50%), Plagioclase (10%), Microcline (5%), Quartzite (5%)	Charcoal (5%)	Speckled/speckled	Granular/chamber	Rounded aggregate redoximorphic nodules in the fine material (100-2000 μ m).
<i>Area 2</i>	Enaulic	1:4	Quartz (50%), Plagioclase (10%), Microcline (5%)		Dotted/speckled	Channel/chamber	Hypo-coatings formed at the edges of the sub-angular peds
<i>Area 3</i>	Gefuric	3:2	Quartz (50%), Plagioclase (10%), Microcline (5%),	Plant (2%), Charcoal (5%)	Speckled/speckled	Channel	Rounded aggregate redoximorphic nodules in the fine material (100-2000 μ m). Hypo-coatings formed at the

			Quartzite (5%), Feldspar (5%)				edges of the sub-angular peds
MM5	Gefuric	1:1	Quartz (50%), Plagioclase (10%), Microcline (5%), Quartzite (5%), Feldspar (5%), Quartzite (5%), Biotite (5%), Glauconite (2%)	Plant (2%), Charcoal (5%)	Cloudy/grano-, poro- and partial striations	Channel	Typic and aggregate redoximorphic nodules (5%) in the fine matrix, with calcite coatings (5%) on the surface of the channel voids.

Biographies

David K. Wright (Ph.D. 2005, University of Illinois at Chicago) is Assistant Professor of Archaeology at Seoul National University. His interests are sedimentary geoarchaeology, radiometric dating and human interactions with climate change.

Scott MacEachern (Ph.D. 1991, University of Calgary) is Professor of Anthropology at Bowdoin College. His main research interests are in state formation processes in Africa, the archaeological study of ethnicity and social boundaries, African cultural heritage management issues and African and global historical genetics.

Jungyu Choi (B.A. 2015, Seoul National University) is M.A. Student of Archaeology at Seoul National University. His interests are geoarchaeology, luminescence dating and change of human subsistence.

Jeong-Heon Choi (Ph.D. 2004, Seoul National University) is Principle Researcher and Director of the Geochronology Group at the Korea Basic Science Institute. His interests are Optically Stimulated Luminescence dating, geochemistry and geomorphology.

Carol Lang (PhD 2014, University of York) is Post-doctoral Research Associate at the University of York. Her main research interest are soil/sediment geoarchaeology and its human legacy in and Africa, human resource management and their effects on historic ecosystem and Iron Age vitrification of hillforts.

Jean-Marie Datouang Djoussou (Ph.D. 2012, Université Laval) is a member of the DGB Archaeological Project. His interests are in questions of indigenous cultural heritage concepts and in cultural heritage management in Africa and worldwide, and in social change in the African Iron Age.



Click here to access/download
Supplementary material
WrightEtAl_S1.docx

